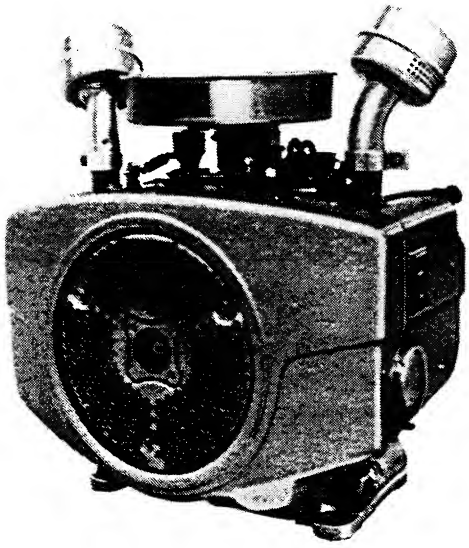
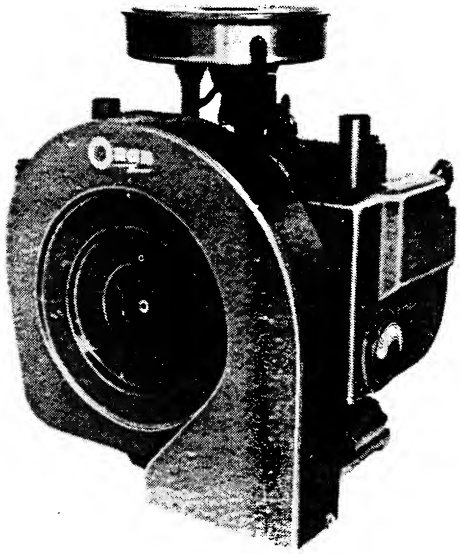
Onan Operators Manual

SERIES
NHB-NHBV Engine





Onan Corporation
1400 73rd Avenue Northeast
Minneapolis Minnesota 55432

Printed in U.S.A.

940-0153
8-80
(SPEC D)

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

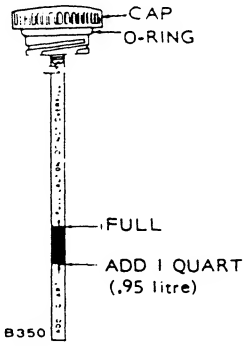
PRE-START INSTRUCTIONS

BEFORE STARTING

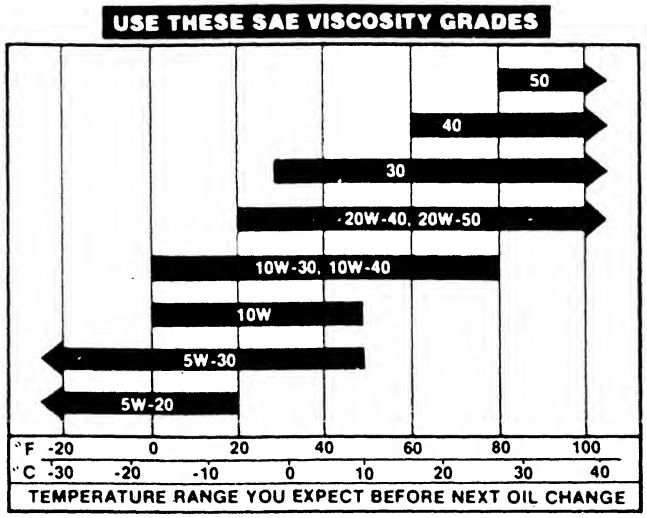
Inspection: Inspect the engine visually before starting. Check for loose or missing parts and any damage which may have occurred in shipment.

Crankcase Oil: Be sure the crankcase has been filled with oil to the "FULL" mark on the oil level indicator. Use oil with the API (American Petroleum Institute) designation SE or SE/CC. Do not mix brands or grades of motor oil. Recommended oil numbers for expected temperatures are listed in the oil chart.

WARNING **Do not remove the dipstick while the engine is running. Oil may blow out the oil fill tube causing injury.**



OIL LEVEL INDICATOR



CAUTION **Do not overfill crankcase. Overfilling causes the oil to foam and enter the breather system. Do not use service DS oil or damage to the engine could occur.**

Recommended Fuel: Use regular gasoline for the first 25 hours to allow the rings to seat properly. Then use only clean, fresh, unleaded or regular grade gasoline. Using unleaded gasoline results in less maintenance. If regular gasoline is used continuously, carbon and lead deposits must be periodically removed from the cylinder head to avoid loss of engine power. DO NOT USE HIGHLY LEADED PREMIUM FUELS.

CAUTION **If an engine is switched to unleaded gasoline after an extended period of operation with regular gasoline, all carbon and lead deposits must be removed from the cylinder heads. Failure to remove deposits could lead to preignition and result in damage to the engine if operated with unleaded gasoline.**

WARNING **Never fill the tank when the engine is running. Overflowing gasoline fumes may ignite causing a fire or explosion. Leave some space in the tank for fuel expansion.**

STARTING

STARTING (Electric Start)

1. Turn the ignition switch on, pull the choke lever way out (for a cold engine) and push the start switch.
2. When the engine starts, gradually push the choke lever in until the engine runs smoothly.
3. Black smoke from the exhaust and a rough running engine usually indicate over-choking.
4. To stop the engine, turn the ignition switch to the "Off" position.

If the engine fails to start at first attempt, rust inhibitor oil used at the factory may have fouled the plugs. Remove the plugs, clean in a suitable solvent, dry thoroughly and reinstall. Heavy exhaust smoke when the engine is initially started is normal and usually caused by rust inhibitor oil.

STARTING (Manual Start)

1. Hold choke about three quarter way closed or as necessary according to temperature conditions.
2. Pull start rope with a fast steady pull to crank engine. Do not jerk.
3. Open choke as engine warms up.

STOPPING THE ENGINE

Disconnect all load before stopping the engine. Engines equipped with battery ignition are stopped by positioning the ignition switch to the OFF position.

GENERAL INFORMATION

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment. Refer to the *ENGINE SAFETY PRECAUTIONS* section for a summary of general safety precautions.

WARNING **This symbol is used throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

It is recommended that you read your engine manual and become thoroughly acquainted with your equipment before you start the engine.

ENGINE MODEL REFERENCE

Identify your model by referring to the MODEL and SPEC (Specification) NO. as shown on the unit nameplate. Always use this number and the engiine serial number when making reference to your engine or when ordering repair parts.

Onan recommends that all major service be performed by qualified service personnel. An engine service manual and complete parts catalog are available at additional cost. Contact your nearest authorized dealer or Onan Parts and Service Center.

REFERENCE MANUALS

Parts Catalog 940-0403
Major Service Manual 940-0753

These instructions contain the SI metric equivalents following immediately in parentheses after the U.S. customary units of measure.

SPECIFICATIONS

Displacement	60 cu. in. (983 cm^3)
Cylinder Bore	3.563 inch (90.5 mm)
Piston Stroke	3 inch (76 mm)
Horsepower	
NHB @ 3000 rpm	17.5 BHP (13.1 kW)
NHBV @ 3200 rpm	19.5 BHP (14.5 kW)
Compression Ratio	
NHB, NHBV	6.3 to 1
Oil Capacity	3.5 quart (3.3 litre)
Oil Capacity with Filter Change	4 quart (3.8 litre)

TUNE-UP SPECIFICATIONS

Spark Plug Gap	0.025 inch (0.64 mm)
Breaker Point Gap	0.016 inch (0.41 mm)
Ignition timing (Static)	20° BTC
Valve Lash (Cold)	
Intake	0.003 inch (0.08 mm)
Exhaust	0.012 inch (0.30 mm)

OUT-OF-SERVICE PROTECTION

Protect an engine that will be out-of-service for more than 30 days as follows:

1. Run the engine until it reaches normal operating temperature.
2. Turn off the fuel supply and run the engine until it stops.
3. Drain oil from oil base while the engine is still warm. Refill with fresh crankcase oil and attach a tag stating viscosity used.
4. Remove spark plugs. Pour 1 ounce (2 tablespoons or 28 grams) of rust inhibitor or SAE #50 oil into the cylinders. Crank the engine over a few times. Reinstall spark plugs.
5. Service air cleaner as outlined in *MAINTENANCE* section.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.
10. If battery equipped, disconnect and follow standard battery storage procedure.

RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperatures.
3. Clean and check battery. Measure specific gravity (1.260 at 77° F [25° C]) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If the level is low, add distilled water and charge until specific gravity is correct. DO NOT OVERCHARGE.
4. Check that fuel filter and fuel lines are secure, with no leaks.
5. Check carburetor, adjust if necessary.
6. Connect battery.
7. Refer to *STARTING* section for starting procedures.

After engine has started, excessive blue smoke is exhausted until the rust inhibitor has burned away.

OPERATION

BREAK-IN PROCEDURE

Controlled break-in is the ideal fitting of all internal moving metal parts. Using the proper oil and applying a conscientious maintenance program during this period helps assure satisfactory service from your Onan engine.

Maintain the proper cooling and lubrication during break-in. Run the engine at half load for the first three hours with intermittent periods of full load to control engine break-in.

CAUTION **Using the wrong grade and weight of oil and high engine operating temperature during break-in can cause engine damage.**

Check the oil level at least every five operating hours. Add oil to keep it at the proper level, but never overfill as overfilling may cause the oil to foam and enter the breather system.

HOT WEATHER OPERATION

When operating the engine in temperatures above 75° F (24° C), pay particular attention to the following items to prevent damage:

1. Keep the engine cooling fins clean and free of obstruction.

CAUTION **Plugged or clogged cooling fins can cause overheating and engine damage.**

2. See that nothing obstructs air flow to and from the engine.
3. Ensure that you are using the proper grade and weight of oil for ambient temperatures. Check the oil level each time you fill the fuel tank.
4. Check the battery water more frequently than every 50 hours which is recommended under normal conditions. High temperatures cause faster evaporation.

COLD WEATHER OPERATION

When the engine is being used in temperatures below 32° F (-0° C), check the following items closely:

1. Use the correct grade and weight of oil for the temperature conditions. Change the oil only when the engine is warm. If an unexpected temperature drop occurs when the engine is filled with summer oil, before starting the engine, move it to a warm location until the oil will flow freely.
2. Use fresh fuel. Fill the fuel tank after each day's use to protect against moisture condensation.
3. Keep the battery in a well-charged condition.

DUST AND DIRT

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as required.
3. Change crankcase oil and filter more often than recommended under normal conditions.

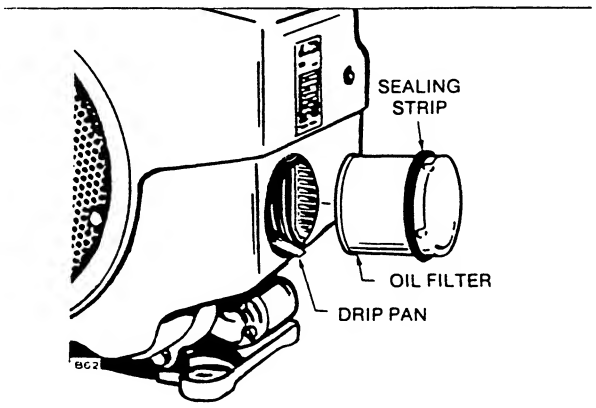
MAINTENANCE

CRANKCASE OIL

Oil Level: Check oil level at least every 8 hours of operation. Check more frequently on a new or reconditioned engine as oil consumption is higher until the piston rings seat properly.

Oil Change: Change crankcase oil after the first 25 hours of operation; change every 100 hours after that. If operating in extremely dusty conditions, change oil more frequently.

Oil Filter: Change the oil filter every 200 hours. Remove the filter (see Figure) by turning counterclockwise, using a filter wrench. Add the strip provided with the filter to prevent air loss in the area indicated. It is advisable to wipe dry the drip pan located below the filter. Coat rubber gasket on filter with a film of oil before installing. Install the filter finger-tight plus 1/4 to 1/2 turn. If oil becomes so dirty that the markings on the oil level indicator cannot be seen, change the filter and shorten the filter service period.



OIL FILTER

BATTERY

Check charge condition. The specific gravity should be approximately 1.260 at 77° F (25° C). Check electrolyte level and add distilled water to keep electrolyte at its proper level. Immediately after adding water in freezing weather, operate engine until battery is fully charged. Keep battery connections tight and clean.

ADJUSTMENTS

CARBURETOR

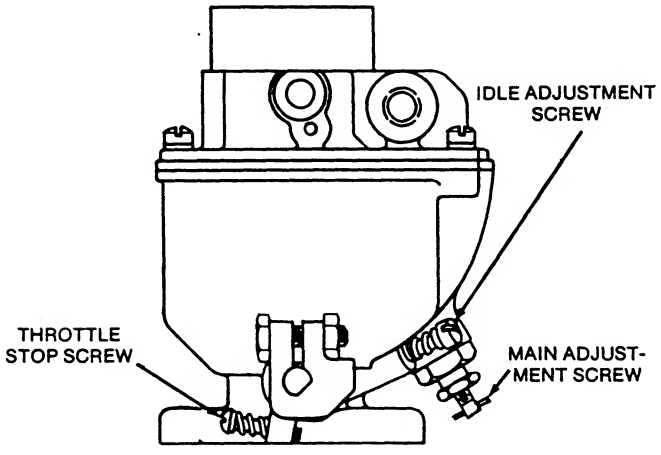
The carburetor idle and main mixture screws were set for maximum efficiency at the factory and should normally not be disturbed. If adjustments seem necessary, first be sure the ignition system is working properly and is not the source of the problem.

If adjustment is needed, proceed as follows:

1. Turn both the main fuel and idle fuel adjustment screws in until lightly seated and then back them out 1 to 1-1/2 turns. Loosen the packing nut (see Figure) before turning the main fuel adjustment screw and tighten after making the adjustment.

CAUTION **Forcing the mixture adjustment screws tight will damage the needle and seat. Turn in only until light tension can be felt.**

2. Start the engine and run it for at least 10 minutes to warm it up.
3. Pull the governor arm back so the throttle stop screw is against its stop and hold in this position while completing steps 4 through 6.
4. Adjust the throttle stop screw to obtain 900 rpm.
5. Turn the idle adjustment screw in until engine speed drops and then out until engine speed drops again. Over a narrow range between these two settings, engine speed will be at its maximum. Set the idle adjustment screw about 1/8 turn out from the midpoint of this range.
6. Readjust the throttle stop screw to obtain 900 rpm and then release the governor arm.
7. Increase the engine speed to its normal operating range and apply load to engine if possible. Loosen the packing nut and adjust the main adjustment screw in until speed drops and out until speed drops again. Over a narrow range between these two settings, engine speed will be at its maximum. Set the main adjustment screw about 1/8 turn out from the midpoint of this range and tighten the packing nut.



CARBURETOR ADJUSTMENTS

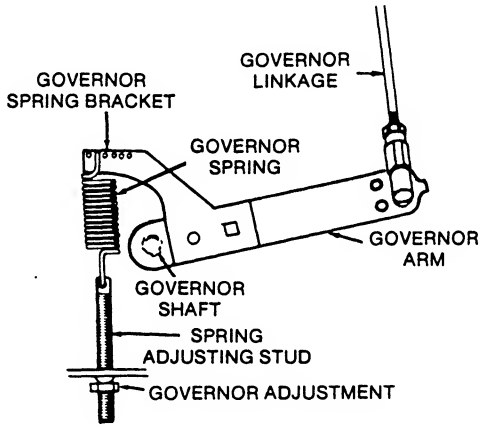
8. Check the main mixture adjustment by rapidly accelerating the engine from idle to full speed. The engine should accelerate evenly and without hesitation. If it does not, readjust the main adjustment screw outward in 1/8 turn increments until the engine accelerates smoothly, but do not turn it out more than 1/2 turn beyond the original setting.

GOVERNOR ADJUSTMENT

The governor should allow a nominal engine speed of 2400 rpm at no load. The no load speed should be slightly higher (90 rpm) than the speed requirements of the connected load. Using a tachometer, check engine speed and adjust the governor as follows.

Speed: Turn speed adjusting nut in to increase speed or out to decrease speed. See Figure.

Sensitivity: Referring to Figure below, move spring toward governor shaft to increase sensitivity and away from governor shaft to decrease sensitivity.



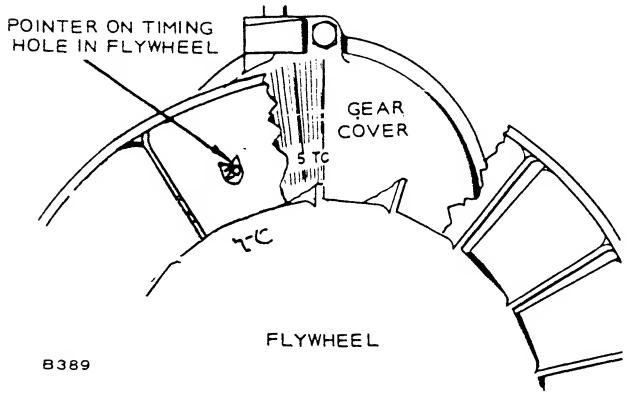
GOVERNOR ADJUSTMENTS

BREAKER POINTS (Cold Setting) IGNITION TIMING

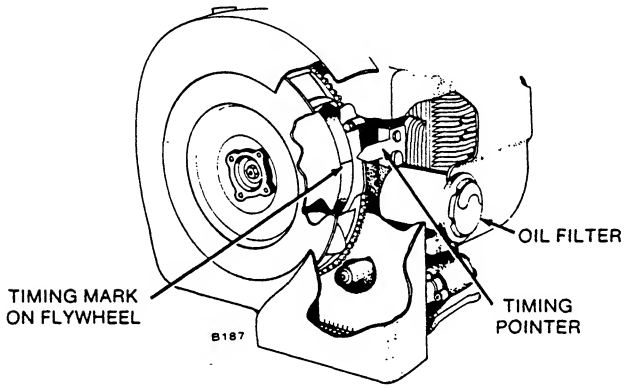
To maintain maximum engine efficiency, change the breaker points every 200 hours of operation. Proceed as follows:

1. Remove spark plugs and rotate flywheel TC mark clockwise to 20° BTC (points open).
2. Remove breaker box cover.
3. Remove two Allen screws (C) and lift breaker assembly from engine.
4. Replace condenser and point assembly with new parts and reinstall using above procedure in reverse order of removal.
5. Connect an ohmmeter or a continuity test lamp set across the ignition breaker points. Touch one test probe to the breaker box terminal to which the coil lead is connected and touch the other test probe to a good ground on the engine.

6. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).

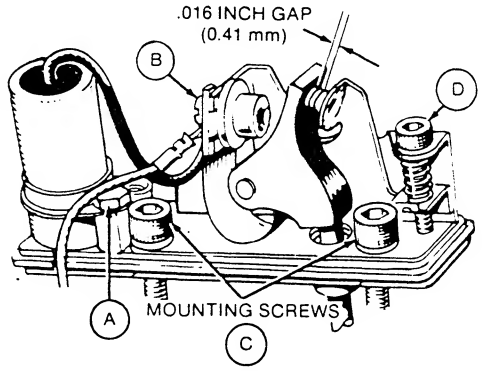


PRESSURE COOLED ENGINES: VIEW TIMING HOLE AND TIMING MARKS THROUGH BLOWER SCREEN



VACU FLO ENGINES: REMOVE AIR SHROUD FROM RIGHT CYLINDER TO VIEW TIMING MARKS

7. The lamp should go out just as the points break which is the time at which ignition occurs (20° BTC). If timing is early (large point gap) or late (small point gap), adjust point gap using Allen screw (D) so that lamp goes out at 20° BTC with crankshaft rotation clockwise.



SETTING POINT GAP

8. An alternate method may be used for setting breaker point gap/ignition timing if a continuity lamp or ohmmeter is not available or timing marks cannot be seen. Rotate crankshaft clockwise (facing flywheel) by hand until the points are fully open. Set the point gap (using flat feeler gauge) at .016 inch (0.41 mm) by adjusting the Allen screw (D) inward or outward.

Make sure feeler gauge is clean and free of any grease, oil, or dirt.

The timing is adjusted during initial engine assembly at the factory and is fixed by the point gap adjustment. A .016 point gap is equivalent to 20° BTC.

9. Replace breaker box cover, coil wire, spark plugs, and spark plug cables.

PERIODIC SERVICE GUIDE

PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	25	50	100	200
Inspect Engine Generally	x[1]				
Check Oil Level	x				
Service Air Cleaner			x[2]		
Change Crankcase Oil				x[2]	
Check Battery Electrolyte Level			x		
Clean Cooling Fins			x		
Replace Oil Filter (if used)					x[2]
Replace Spark Plugs					x
Check Breaker Points				x	
Clean Breather Valve					x[4]
Replace Air Cleaner Element					x[4]
Check Valve Clearance			x[3]		x[4]
Compression Check					x

x[1] - Check for fuel leaks. With engine running, check the exhaust system both visually and audibly for leaks.
x[2] - Perform more often in extremely dusty conditions.
x[3] - Initial break-in check only.
x[4] - For detailed maintenance, contact an Onan Service Center.

MAINTENANCE

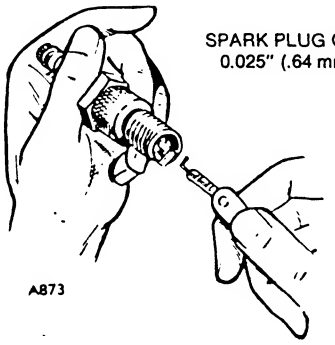
COOLING SYSTEM

Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

CAUTION **Plugged or clogged cooling fins can cause overheating and engine damage.**

SPARK PLUGS

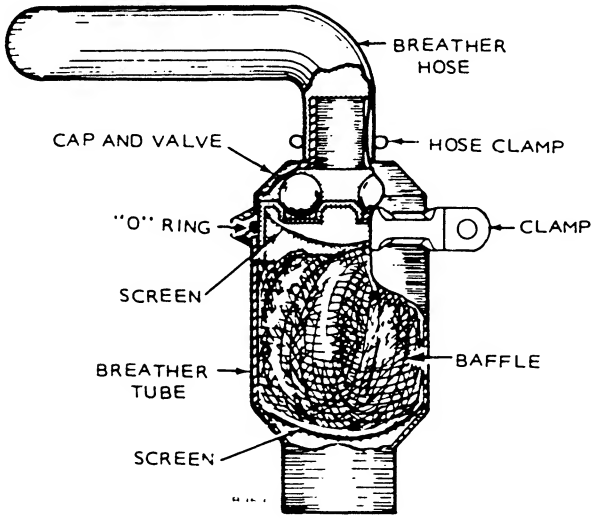
Check, clean and reset spark plugs every 200 operating hours. Replace spark plugs that show signs of fouling or electrode erosion.



SETTING SPARK PLUG GAP

CRANKCASE BREATHER

This engine uses a crankcase breather valve for maintaining crankcase vacuum. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, the crankcase breather requires cleaning. After every 200 hours of operation, wash the valve in a suitable solvent and clean the baffle.

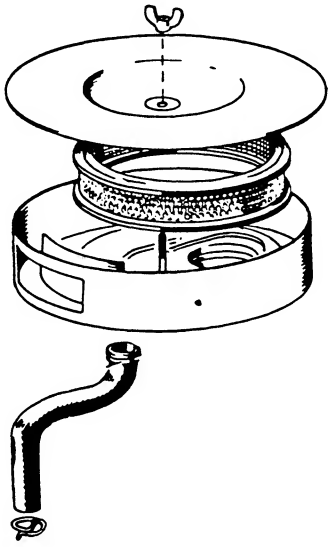


CRANKCASE BREATHER

AIR CLEANER

Check air cleaner paper element every 50 hours. Clean element by tapping to shake off dirt. Depending on operating conditions for the engine, replace the paper element every 200 hours or whenever it becomes dirty. Clean air cleaner canister whenever element is removed.

CAUTION **Do not run engine with air cleaner removed. Intake of dirty air or solid materials could cause severe damage to engine parts.**



AIR CLEANER ASSEMBLY

EXHAUST SYSTEM

Make regular inspections of the exhaust system throughout the entire life of the engine. Locate leaks in muffler and piping while the engine is operating. Repair all leaks immediately after they are detected for personnel safety.

WARNING **Leaky exhaust systems emit noxious carbon monoxide fumes which are a potential safety hazard in enclosed areas.**

BREAKER POINTS

Check breaker points every 100 hours. Replace points every 200 operating hours. Replace points sooner if they are pitted or burned. See *ADJUSTMENTS* section.

Onan recommends that all major service be performed by qualified service personnel. An engine service manual and complete parts catalog is available at additional cost. Contact your nearest authorized dealer or Onan Parts and Service Center.

ENGINE SAFETY PRECAUTIONS

It is recommended that you read your engine manual and become thoroughly acquainted with your equipment before you start the engine.

WARNING **This symbol is used throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

Safety Codes

- All local, state and federal codes should be consulted and complied with.

General

- Provide appropriate fire extinguishers and install them in convenient locations. Use an extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the engine are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- If it is necessary to make adjustments while the engine is running, use extreme caution when close to hot exhausts, moving parts, etc.

Protect Against Moving Parts

- Do not wear loose clothing in the vicinity of moving parts, such as PTO shafts, flywheels, blowers, couplings, fans, belts, etc.
- Keep your hands away from moving parts.

Batteries

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine.
- DO NOT SMOKE while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or by smoking.
- Verify battery polarity before connecting battery cables. Connect negative cable last.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment.
- DO NOT smoke or use an open flame in the vicinity of the engine or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle enough to break.
- Be sure all fuel supplies have a positive shutoff valve.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. All engine installations, especially those within a confine, should be equipped with an exhaust system to discharge gases to the atmosphere.
- Do not use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Ensure that exhaust manifolds are secure and are not warped by bolts unevenly torqued.

Engine Exhaust Gas (Carbon Monoxide) is Deadly!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

Cooling System

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator pressure cap while the engine is running. Bleed the system pressure first.

Keep the Unit and Surrounding Area Clean

- Make sure that oily rags are not left on or near the engine.
- Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.